# *Title:* *Steady state analysis for audiovisual attentional switch*

PRESENTER:
**Bertille** Somon

## Background

- Optimal distribution of attention is essential for **multitasking** activities (e.g. driving a car, flying a plane)
- Tradeoff in resources allocation with **limited resources** available
- People tend to **switch** their attentional focus during multitasking activities
- But … if task demand is too high: **disruption** of **non-primary** task networks → missing critical information

**Aim: It is essential to characterize these networks during cross-modal attentional switching tasks**

## Methods

**N=14**
Adult with no visual/auditory impairment
28.75±1.66 y.o. / 7 ♀+7 ♂

**2 participants removed**

**Experiment (~1h):**
- **Audiovisual steady-states-based attentional switch**

Two concurrent streams :
Visual → **48Hz** flickering black and white checkboard
Auditory → 500Hz sine tone modulated at **40Hz**
- **Stimulus detection task**

Trains of **2**/3/4 consecutive stimuli
Visual: red dots (fig. 2a)
Auditory: 200% ampllitude bips (fig. 2b)

**Protocol:**
**30% of targets: trains of 2 stimuli**

5 audio blocks: focus on auditory targets (2 bips)
5 visual bocks: focus on visual targets (2 dots)
10 audiovisual switching blocks (see fig. 2c)

Button press for auditory (« a ») or visual (« p ») target detection

**Data acquisition:**
- **Electrophysiological**

64 Ag-AgCl active electrodes + actiCHamp amplifier
**Continuous recording and streaming (LSL):** $F_s$ = 500Hz
- **Behavioral**

Responses and Reaction times to targets

**(Pre-)processing:**
- High-pass Hamming-windowed FIR
- 50Hz ZapLine
- Bad channel removal and interpolation
- Re-reference: TP9+TP10
- ASR: cutoff = 5
- Picard ICA: eye IC removal

Epoching: [-2;2]s around targets
Frequency decomposition: θ, α, β, γ frequency bands

**Analyses:**
**Hit rate & RT**
ANOVA: condition (unimodal vs. switch) and modality (visual vs. audio)
**Rythmic Entrainment Source Separation (RESS)** at audio/visual steady-state frequencies

**To be coming:**
Cluster-based permutation test: AOI selection
Directed connectivity: DTF
α/θ cross-frequency coupling

# Performances to attentional **switching** seem affected by the **modality** which also shows on the spectral power displayed by **RESS**

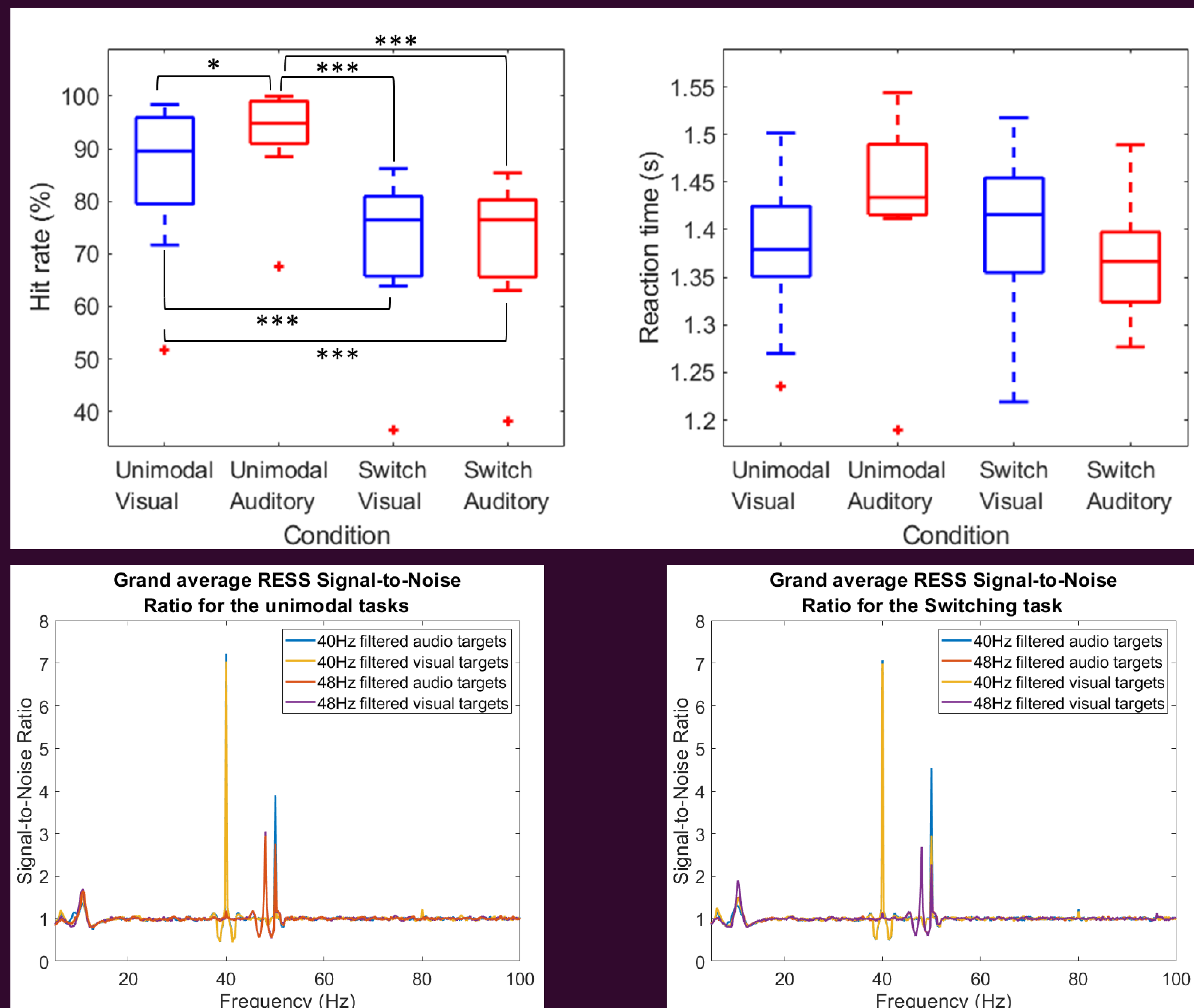


**Figure 1 -** Behavioral results (top) and RESS-transformed EEG activity related to the 4 experimental conditions: **unimodal** and **switching** tasks (respectively left- and right-hand side of both top graphs; left and right bottom graphs) for the **visual** and **auditory** target detection.

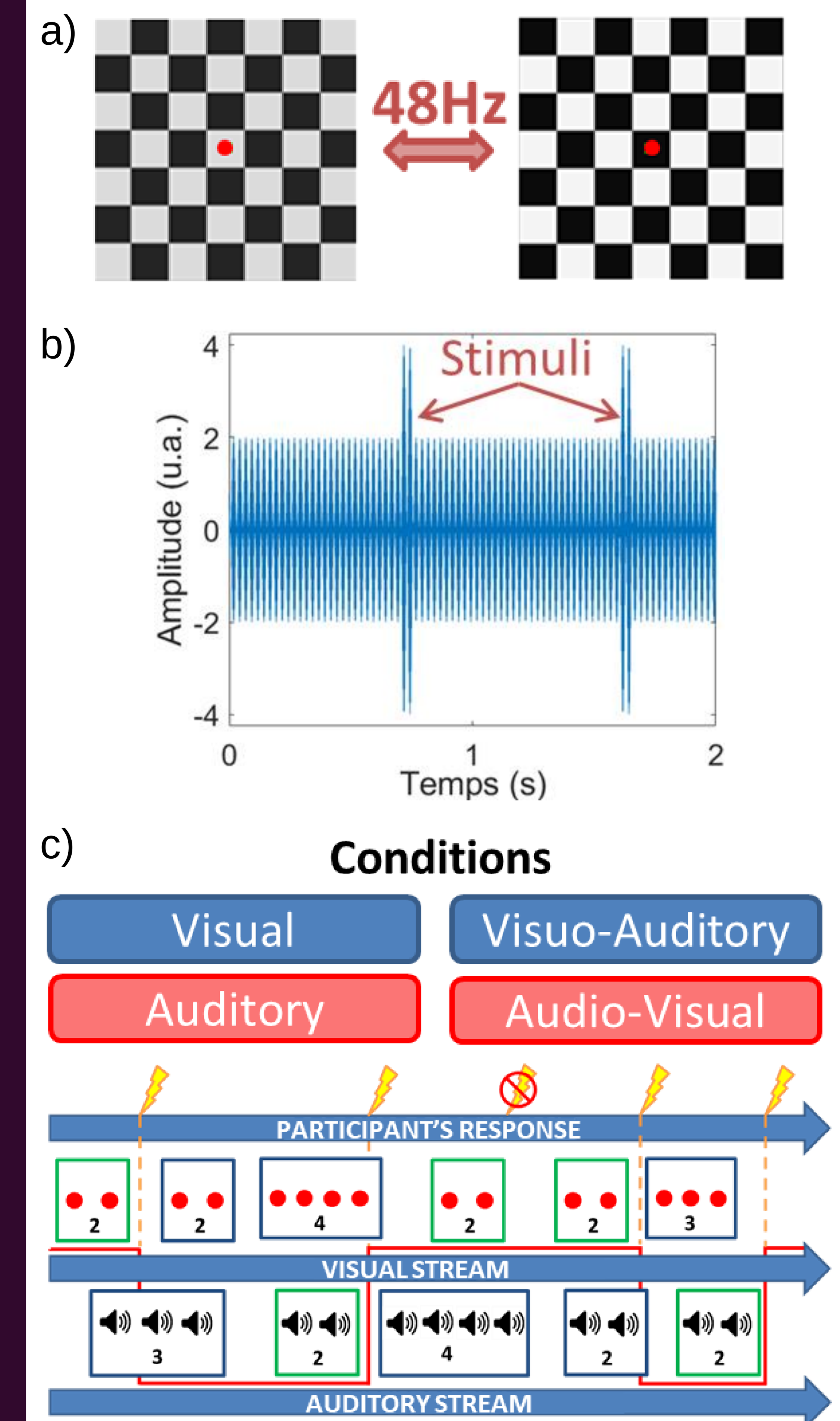


**Figure 2 -** Steady-state stream (checkerboard) and stimuli (red dot) for the visual (a) and auditory (sine wave and 200% amplitude tones; b) for the audiovisual attentional switching task. (c) Experimental conditions and task representation showing the « attentional flow » of the participant (red line) when answering (or not – third target) to target stimuli trains going from the visual modality ("visual stream", middle line) to the auditory modality ("auditory stream", bottom line) presented simultaneously.


**References:**
[1] Todd, J. J., Fougnie, D., & Marois, R. (2005). Visual short-term memory load suppresses temporo-parietal junction activity and induces inattentional blindness. *Psychol. Sci.*, 16(12), 965-972.
[2] Saupe, K., Schröger, E., Andersen, S. K., & Müller, M. M. (2009). Neural mechanisms of intermodal sustained selective attention with concurrently presented auditory and visual stimuli. *Front. hum. neurosci.*, 3, 58.
[3] Cohen, M. X., & Gulbinaite, R. (2017). Rhythmic entrainment source separation: Optimizing analyses of neural responses to rhythmic sensory stimulation. *NeuroImage*, 147, 43-56.



**Bertille** Somon,
Aurélien Fermo,
Caroline P.C. Chanel
Frédéric Dehais


isae SUPAERO Institut Supérieur de l'Aéronautique et de l'Espace
ANITI Université Fédérale Toulouse Midi-Pyrénées